DOCUMENT RESUME

ED 055 346 EA 003 746

TITLE	Relocatale Learning Facilities.
INSTITUTION	Ontario Dept. of Education, Toronto. School Planning and Building Research Section.
PUB DATE	Oct 70
NOTE	33p.
AVAILABLE FROM	School Planning and Building Research Section, Ontario Department of Education, 44 Eglinton Ave., West, Toronto 12, Ontario (Canada) ($1.50)
EDRS PRICE	MF-$0.65 HC Not Available from EDRS.
DESCRIPTORS	Building Design; Classroom Design; Community Attitudes; *Design Needs; Educational Environment; Educational Facilities; Enrollment Projections; Facility Requirements; Flexible Facilities; *Mobile Classrooms; Modular Building Design; School Construction; *School Expansion; Student Attitudes; Teacher Attitudes
IDENTIFIERS	Divisible Facilities; *Relocatable Facilities

ABSTRACT

This document supplies guidelines for the future design of structures within one category of relocatable learning facilities--divisible facilities. The current use and average cost of portables; and teacher, student, and community reactions are discussed. Four types of relocatable structures are described: portable, mobile, divisible, and demountable facilities. Design recommendations include minimum standards of heating, ventilation, and lighting. Various plan arrangements for relocatable learning areas in groups of two through six relocatables are illustrated. A related document is EA 003 745. (MLF)

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relocatable learning facilities

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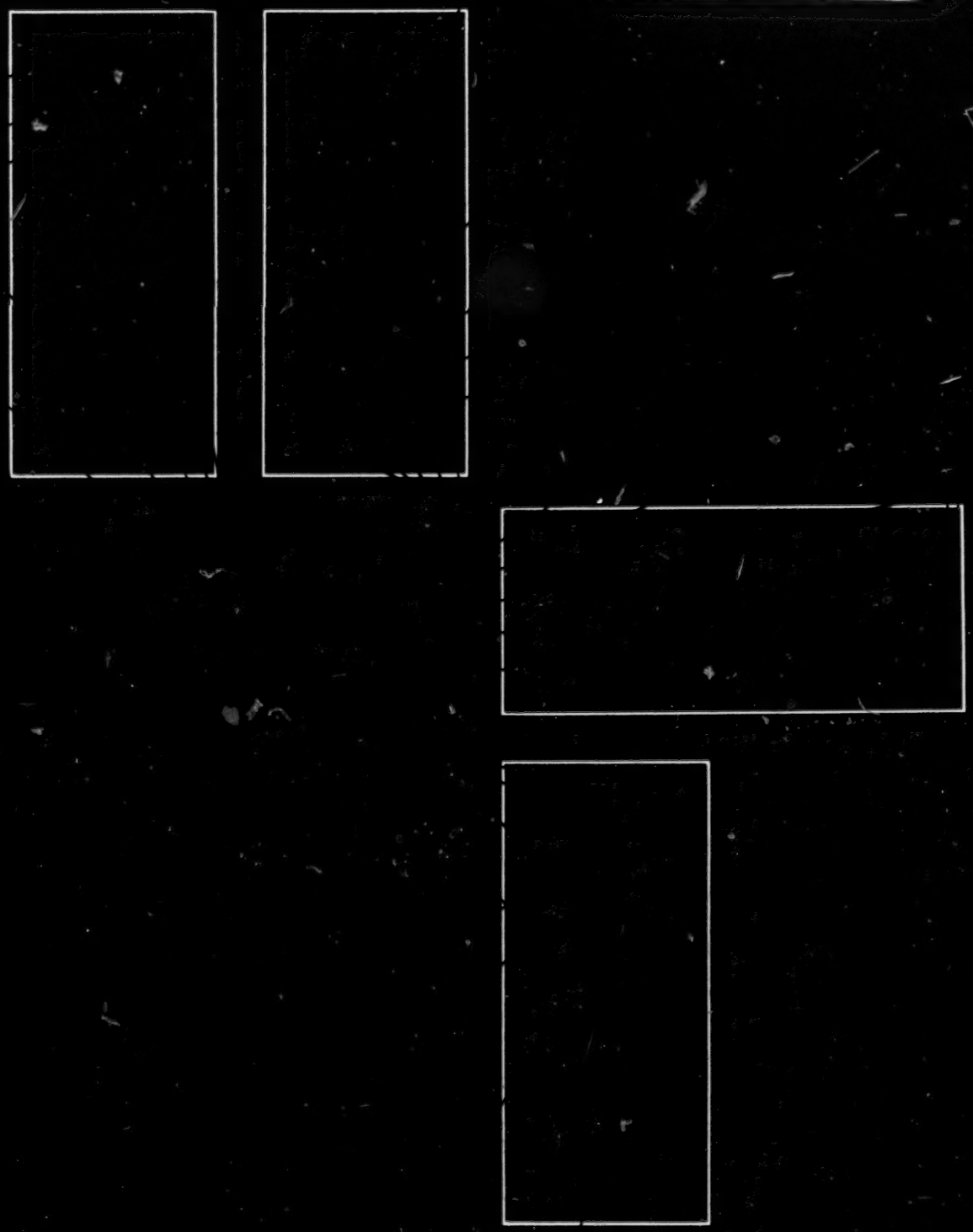

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EA 003 746

Architectural Services of the
School Business Administration Branch
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Prepared by
SCHOOL PLANNING AND BUILDING RESEARCH
in conjunction with
the Ontario Department of Education
Curriculum Section
October 1970

introduction

The use of temporary structures has been considered an extreme emergency measure. Today, however, it is becoming increasingly difficult for boards to provide sufficient learning areas without them. It is thus surprising to find that, although these units are receiving widespread use, the possibilities for design improvement have not yet been fully realized.

The most serious criticisms of the present relocatable learning areas have been:

- their physical isolation from the centre of activity of the parent school and their isolation from each other,
- their lack of adequate ventilation, both mechanical and natural, and of proper distribution of heat,
- the lack of washroom facilities,
- their lack of aesthetic design both inside and outside, and also the lack of proper site planning.

The aim of this publication is to set down guidelines for the future design of structures within one category of relocatable learning areas, divisible facilities.

Portable accommodation, however well designed, is not a permanent answer to the problem of housing students and a policy of "instant portables" should not be substituted for a sound program involving a demographic study and a capital building plan designed to reflect its findings.

Why the need?

The following are probably the most important of a great many factors which contribute to the need for relocatable facilities:

Enrolment

It has been very difficult, in the past, to forecast enrolment accurately with the result that conventional accommodation is insufficient. Further, fluctuating enrolment due to declines or increases in population has an effect on the type of facilities needed.

Students are remaining in school longer with a wider variety of courses and facilities being offered to them.

Population Shifts

Urban

As cities grow, their internal structure changes and many new factors affect a school's enrolment.

(a)

Couples whose families have grown up are moving from their older downtown homes to apartments or the suburbs. Younger couples with their expanding families move into these older homes and place a burden on the limited facilities of the existing school in the district.

(b)

The rezoning of an area from a single-dwelling area to a multiple-dwelling area is likely to increase school enrolment.

(c)

A downtown area with an above average number of children may be rezoned to a high rise area in which children are not allowed. This change results in a surplus of classrooms.

Suburban

Where an area adjacent to a city is rezoned from farm to residential use, houses can be built and occupied, and children present themselves for education within a matter of six to eight months. Planning and building a school can take as long a period as from three to four years.

Since most children moving into a new subdivision are of elementary school age, there is often a heavy demand for places in the elementary school; a few years later the demand is shifted to the secondary school.

Small Communities

The growth of some communities depends in part on the decision of industry to locate there. Rapid expansion can increase school enrolments beyond projected enrolments. Lack of communication between the municipal and school board leaders can result in a serious lack of pupil accommodation in existing schools at a time of increased need. For example, a new ore-find could create the same situation in a small mining town.

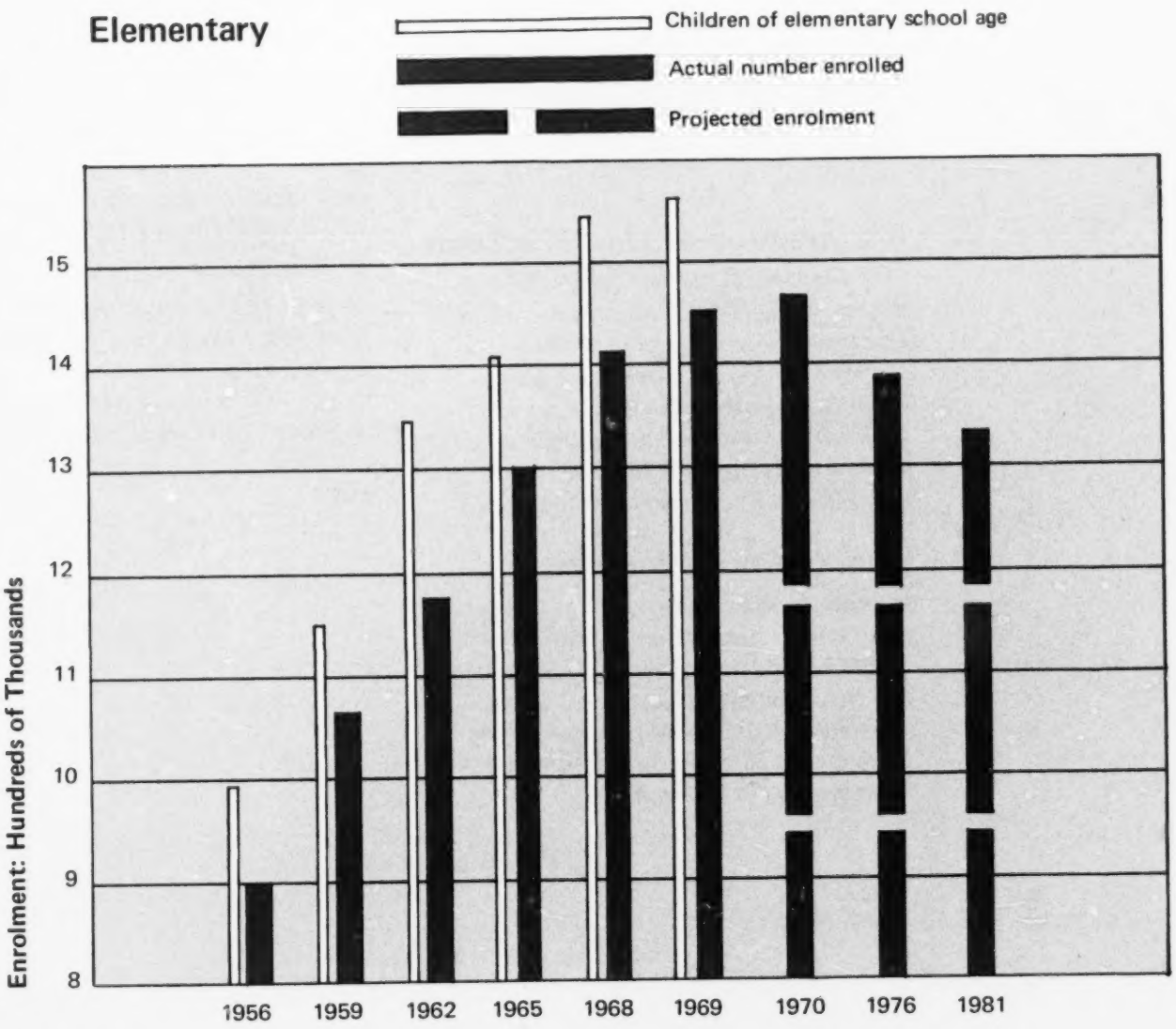
Rural

When several school districts become one unit, it is usually planned well in advance

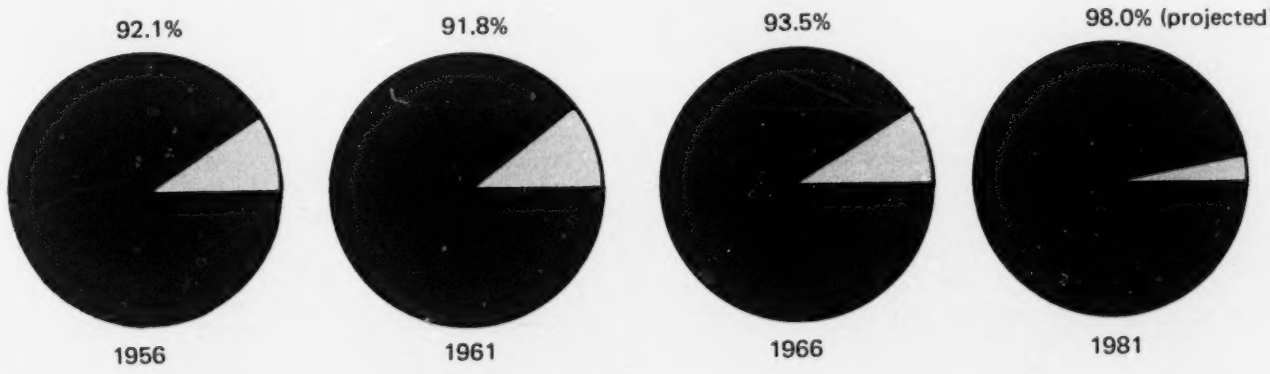
continued

school enrolment in ontario

Elementary



Percentage of Children Aged 5-14 Attending School



Note
Actual enrolment figures taken from the Report of the Minister of Education, 1969.
Enrolment projections supplied by the Ontario Institute for Studies in Education.

but sudden growth in one district can create a sudden need for learning space.

The Time Lag

There is often a two to five-year gap between a school board's recognition of the need for expanded classroom space and the completion of construction ready for student use.

Introduction of New Programs

Portable classrooms have been used during the establishment of colleges of applied arts and technology across the Province, sometimes forming a whole temporary campus. The use of these structures have enabled the educational programs to get underway without the long delay normally associated with permanent construction.

Lack of Communication

In order to forecast the educational needs accurately, co-operation is required among school boards, town planning commissions, and the parents themselves. Where there is a breakdown of communication among these groups, the forecasting of enrolment becomes almost impossible.

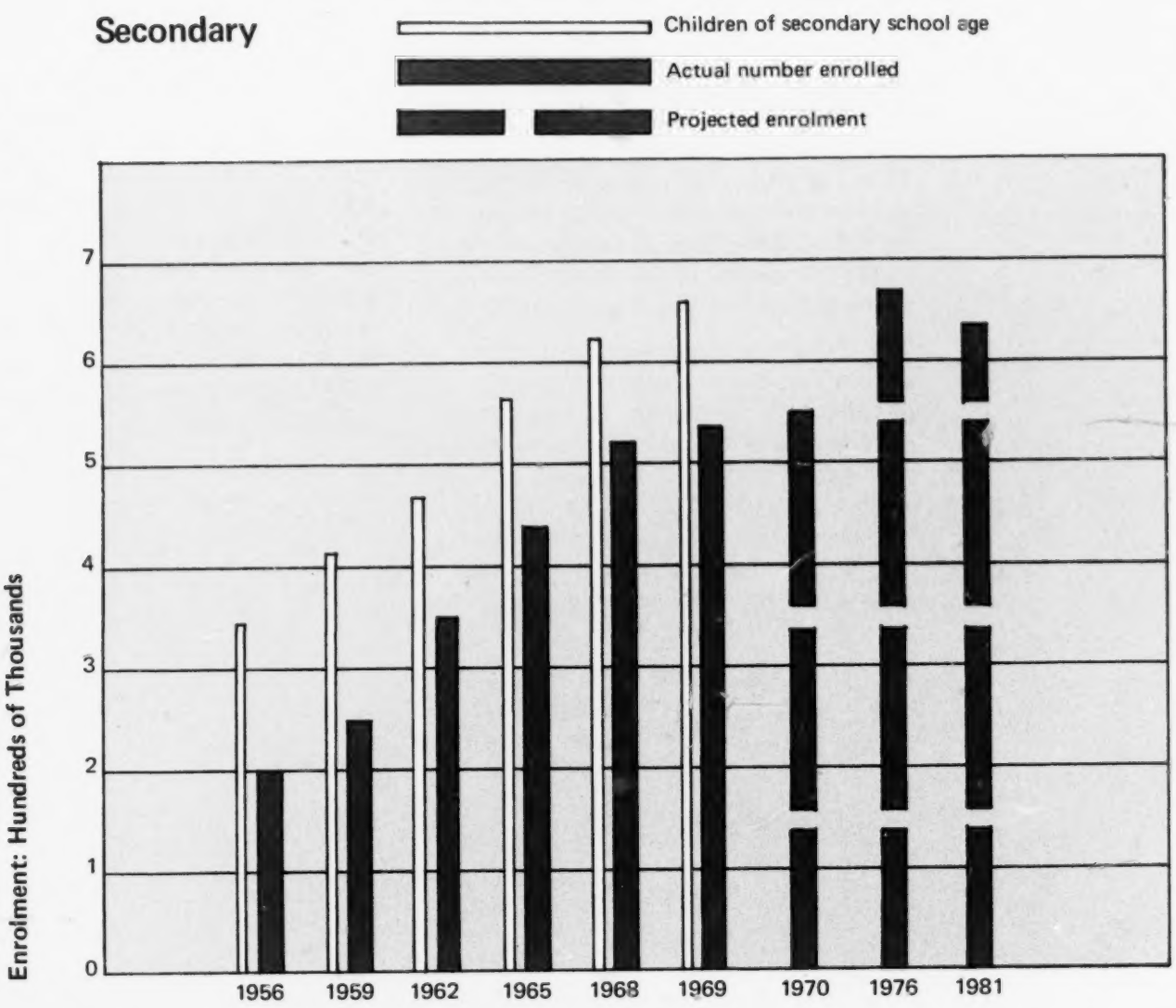
Conclusion

Since the conditions that have been described apparently will be with us at least for the foreseeable future, the relocatable learning facility is more than a stop-gap measure. We must re-evaluate our standards of quality, function, aesthetics, and life expectancy. It is reasonable to assume that today we should expect more than the obviously minimal structures we see around us.

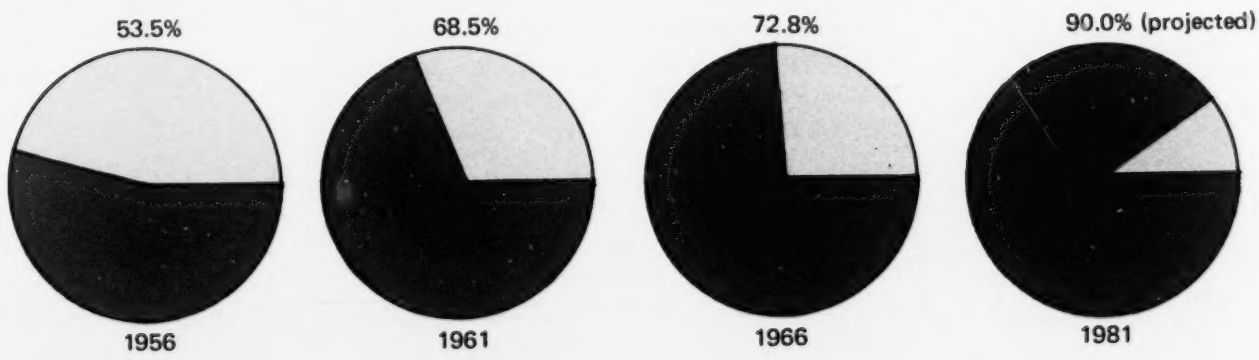
New materials, improved construction methods, and new fabrication techniques utilized by competent and qualified design professionals make it possible to expect a higher standard of design and performance at little or no increase in cost.

school enrolment in ontario

Secondary



Percentage of Children Aged 15 - 19 Attending School



Note
Actual enrolment figures taken from the Report of the Minister of Education, 1969.
Enrolment projections supplied by the Ontario Institute for Studies in Education.

Present use of portables in Ontario

The common practice of larger school boards across Ontario has been to design their own portable structures using Department of Education standards as a guide. The structure is then built by a local contractor, usually a frame construction with various exterior finishes from metal siding to painted plywood. School boards that move many portables over the years agree that plywood sheeting on the exterior, even though it may be covered with some other form of siding, prevents undue "wracking" of the structure during moves and usually ensures a longer life.

One of the boards of education of Metropolitan Toronto estimates that its 276 portable units account for 11.1 percent of its primary and secondary school accommodation. The oldest units have been in use for approximately 16 years. The original units were heated by space heaters, but oil-fired forced-air and more recently electric heating is proving successful in 107 portables.

The latest design incorporates an integral steel frame under it. For moving, wheels are fastened to the frame which fits onto the tractor cab, making the whole unit a trailer in itself. The average unit cost of portables is $7,000 and an average of $600 moving cost per unit.

One school board has found it possible to move two portables a day. A unit is stripped one day and can often be used on a new site the next day. Furniture remains the property of the host school and does not go with the portable as it would add strain to the unit during the move.

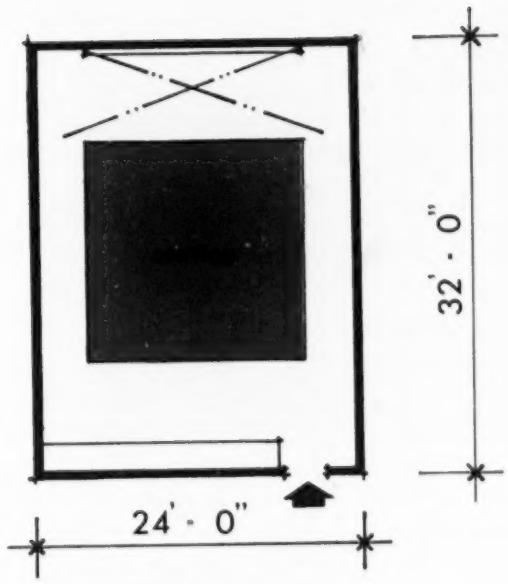
The average unit cost of a portable for one of the large boards in Western Ontario is $8,500 with a moving cost of $500. The economies over the life of the unit will depend on the number of times the unit is moved and the cost of maintenance required by each move.

A Metropolitan board has taken over the deployment of portables for its member boroughs. If there is a need for units in one board's jurisdiction and a surplus in another, it authorizes the move from one borough to another and keeps track of all the portables in use in its area.

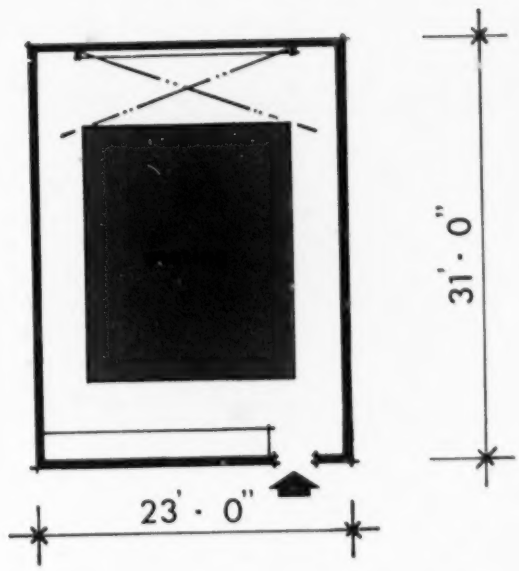
Another large board shows a unit cost of $8,500 and an average moving cost of $340. The board had 426 portables under its jurisdiction during 1969. This was an increase of 92 over the previous year.

The number of new portables in another jurisdiction dropped to 260 in 1969 from 356 in 1967. The average unit cost is $8,500 and the average moving cost is $200 to $300. The following comment was received from the superintendent of planning. "Average costs of moving portables are not too meaningful. Savings can be effected if one crew moves two portables per night instead of one. An additional steel portable at a school may overload that school's electrical system and require the installation of a transformer, thereby increasing the costs of that particular move to about $1,000."

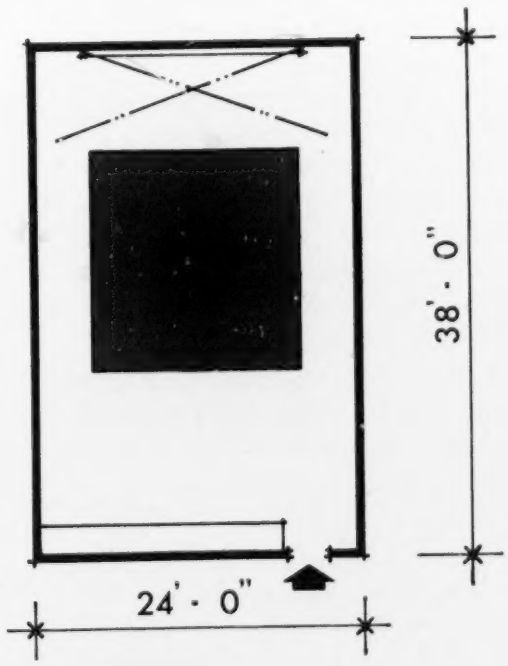
variety in dimensions *



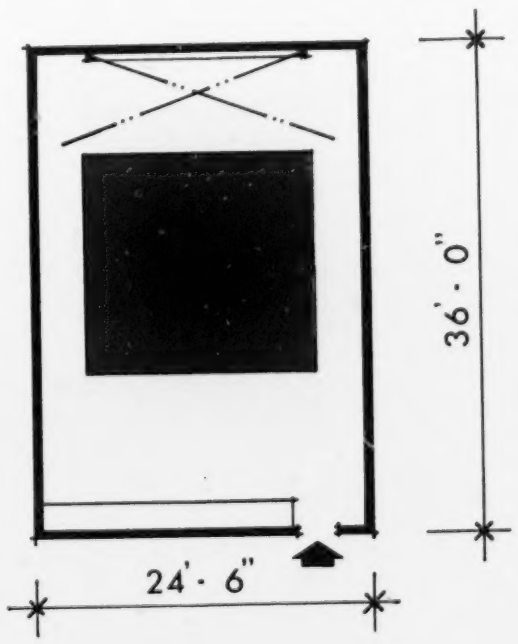
area in square feet = 768
number of students = 35
area per student place = 22



area in square feet = 713
number of students = 35
area per student place = 20.3



area in square feet = 912
number of students = 30
area per student place = 30.4



area in square feet = 882
number of students = 32
area per student place = 27.5

* A selection taken from a survey of portables in use in Canada

Impressions of present units

"Educational shanty towns", "army barracks" or "sheds", are only a few of the adverse descriptions one is likely to hear during a conversation regarding the visual aspects of most present portable facilities.

The fact that many school boards have not had design standards set by qualified professional designers results in a mixed group of buildings in various states of repair. It is understandable that community reaction to the first appearance of the "grey sheds" sitting out in the school yard is usually negative.

When portables are located at one school for a long period of time, many parents feel that their children are being short-changed educationally. In junior high and secondary schools there is also a time loss in changing classes. The normal time required for changing classes is four minutes; if the student is going to a portable, the teacher usually allows five to seven minutes.

The present portables cannot be used readily for special purpose areas such as shops or commercial classes. They are relatively easy to break into and therefore school authorities cannot leave thousands of dollars worth of typewriters or shop equipment in them overnight and they are too small to accommodate some kinds of equipment. Consequently, a disproportionate number of teachers end up in portables. Also since few portables are equipped with water and toilets, they cannot be used as kindergartens.

Portables put a heavier load on school equipment. Because of the difficulty of moving record players, tape recorders, TV sets, and overhead projectors in and out of portables, a teacher takes such equipment for a day at a time rather than for just a period or two.

Although planners and school officials claim portables provide a reasonable amount of desk space, light, chalkboard area, and warmth, it does not always seem to be the case in practice. Sometimes the light is bad because the buildings are placed in the shadow of the main school or at angles to the sunlight. There have been numerous complaints of irregular heating and poor ventilation.

One of the biggest drawbacks is that portables, being only one storey, eat up too much yard space. In some schools in Toronto where land costs up to $350,000 an acre and school sites cannot easily be enlarged, students are simply being squeezed into an ever diminishing play or sports area.

Types of relocatable structures

Portable Facilities

This generally refers to structures (minus foundations), that can be moved without complete dismantling from one site to another.

Clearances

Check clearances of viaducts, overhead power and telephone lines, trees and other obstacles, access to the school site, before moving the portable facility to a new location.

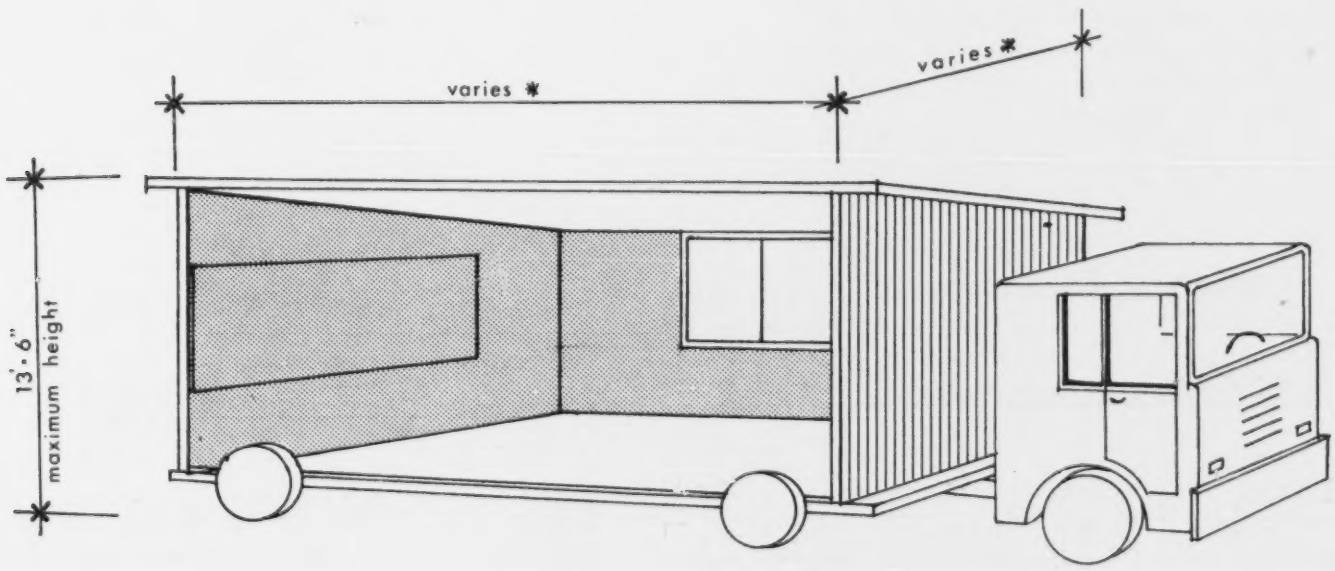
Structural System

The stress and strain of future moves must be calculated in the basic engineering of the portable facility.

Foundation

This can be set on concrete block or wood piers, a perimeter block or poured concrete foundation. The necessity of footings below grade varies with each site.

* for maximum permissible lengths and widths please refer to the ontario highway traffic act sections 52 - 58



Mobile Facilities

This refers to units designed on concepts used for mobile homes (trailers).

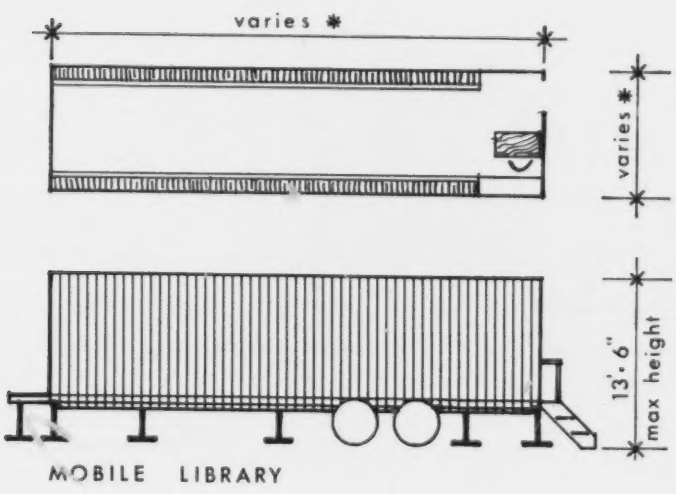
These modified trailers are in effective use as mobile demonstration centres, rolling laboratories, visiting libraries, and special training facilities.

The mobile facility, with its 'bowling alley' proportions, is not considered suitable for normal teaching/learning situations.

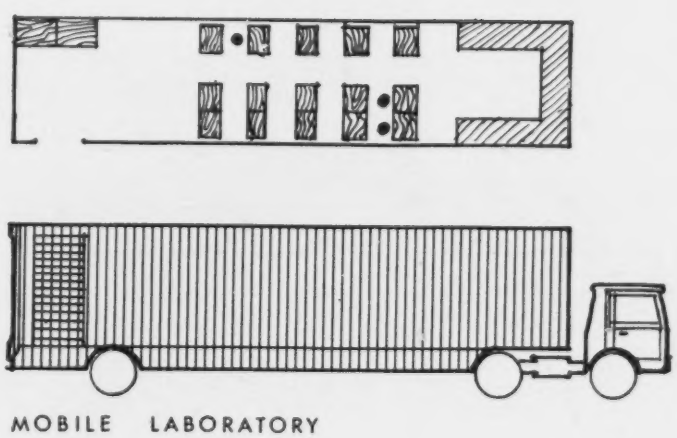
Size *
For maximum permissible lengths and widths, please refer to the ontario highway traffic act. sections 52 - 58

Structural System
A steel carriage is standard. Pulling hitch, axle and wheels can be permanent or removable.
An exterior sheet aluminum skin over wood framing is common.

Foundation
For short visits of a few days or weeks, the mobile facility can be left on wheels and supported by levelling jacks. For longer periods, concrete block piers or perimeter foundation is suitable.



MOBILE LIBRARY


MOBILE LABORATORY

Divisible Facilities

This refers to structures which are planned to fit together and come apart as large modular building components.

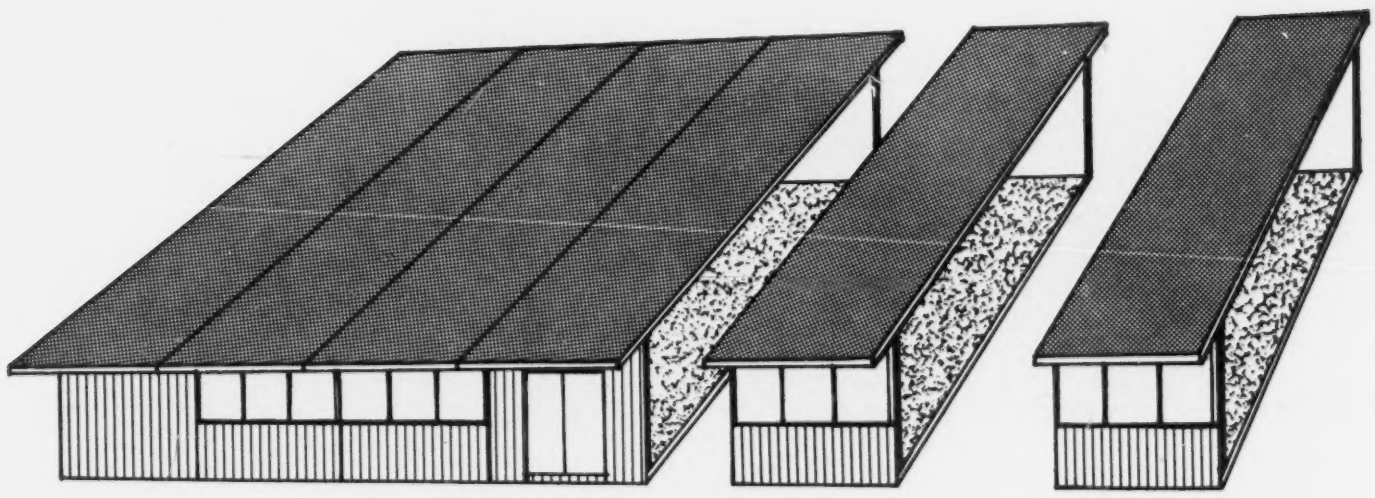
These pre-finished structures (including windows, doors, side walls, roof, flooring and utilities) offer the greatest potential for creating the flexible spaces required by the latest educational philosophy.

Size
For greatest ease of transportation divisible facilities are normally limited to 8' – 10' wide modules. length of units vary from 24' – 36'. The maximum height of 13'-6" in transport (road to roof peak) limits the building height to 10' – 11'.

Structural System
Steel space frames, wood framing, reinforced concrete systems, are all suitable for the structural skeleton.

Tight dimensional tolerances and a proven system for sealing joints and seams are both critical engineering and production demands.

Foundation
Any traditional foundation system, from concrete block piers to a poured concrete perimeter may be used.



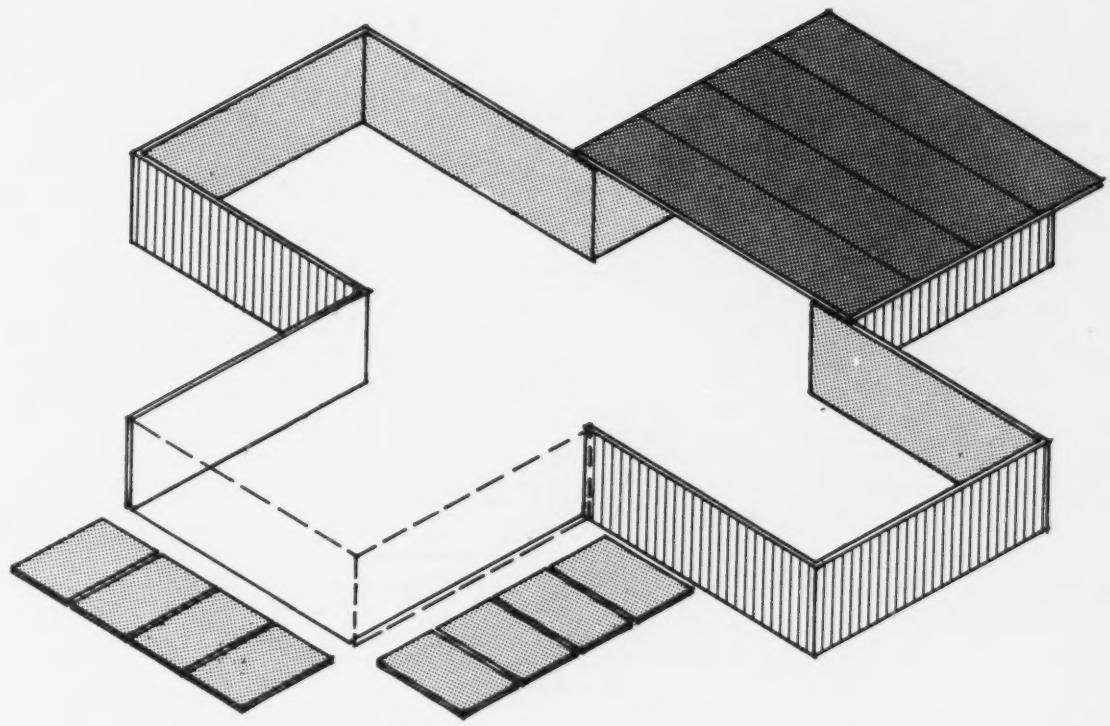
Demountable Facilities

This refers to buildings which can be disassembled and moved to a new site with a comparatively high recovery of building components.

Size
The demountable structure gives complete freedom of design and space accommodations possible, with no limits to height, length, or width, except those imposed by the engineering scheme.

Structural System
Many systems can be employed in demountable buildings, the curtain wall system being the most common.

Foundation
Various types of foundations may be used, ranging from concrete block piers to poured concrete perimeter foundations. The flooring may be planned as recoverable and moved with the structure, or considered expendable as in the case of a full poured concrete slab.



Design recommendations for relocatable learning facilities

During the course of this study, specific information on the needs, causes, construction, size, heating, ventilation, and attitudes of students, teachers, administrators, and parents has been received and condensed. When all this information is studied, the problem is reduced to one specific need. That need is not to provide just "instant" relocatable learning space at the cheapest possible price, but to provide an interior space that has an environment which is suitable for student occupancy and conducive to the learning process.

The exterior is also important: it affects the attitudes of all parties connected with the school and of the people owning property within the immediate area.

The following are points to consider when purchasing or designing learning space that may be relocated several times during its life span.

Materials and Colours

Exterior Materials:
The materials that are to be used on the exterior should be the most durable available consistent with economy. With the new methods of applying finishes to metal surfaces, it is possible to attain an almost damage-proof and maintenance-free exterior.

Surveys have revealed complaints of wind noise in portables with metal siding. This would have more to do with the structural configuration of the siding than the use of metal itself. For example, in the design of the new metal portables that a large borough board purchased in 1967, the roof is a series of formed structural panels that produce a vertical fin of approximately 2 or 3 inches at the joints. This type of detailing contributes to wind noise that has been experienced by some districts.

Exterior Colours
The use of colour through contrasts and detailing can change the box-like appearance and prevent the exterior from deteriorating visually. The colours should create a balance with the buildings in the community while maintaining a clear crisp presentation. Colours and materials that fade, deteriorate, or require a great deal of maintenance should be avoided.

Interior Materials
Maintenance-free and mar-proof materials should be used wherever possible. Vinyl clad metal or vinyl fabric on dry wall will prove to be more durable. In the case of vinyl-clad steel or painted panels, the whole wall system becomes a reference board with the use of magnets. This could be an added advantage in junior, intermediate and senior classes.

As mentioned in the section dealing with acoustics, carpeting is recommended.

Interior Colours
In all probability the colour of the carpet will be dominant, as it will be necessary to have a colour that will not show dirt or soil easily. The visual effect will be broken up by the desks and chairs and therefore will not be distracting. As the room size is often small, light neutral colours should be used on the walls and ceilings to expand the size of the room. Accent colours should be used sparingly and in areas where distraction will be minimized.

Windows and Louvres

Each window should be of the combination type furnished with storm windows, with screens and movable storm panels at the vented portion of the windows.

The windows should start no less than three feet from the interior floor and be of a type that prevents the opening of windows into a passage or play area.

There should be no windows within six feet of the chalkboard in order to prevent glare and reflections.

Blackout facilities should be provided on all windows for the use of audio-visual equipment.

Lighting

Three equally divided parallel rows of fluorescent lighting fixtures which run perpendicular to the students' work surface are recommended. The fluorescent lamps should be warm white.

The maintained learning area illumination should be not less than 70 foot candles at desk level.

Wardrobe, storage and circulation areas should be illuminated by suitable incandescent lighting fixtures.

A light fixture should be provided on the outside of the learning area at each exit.

A single row of fluorescent lighting fixtures should be provided over the chalkboard surface.

Heating and Ventilation

Heating a learning space, or almost any space, is a relatively simple task. The problem of combining heating with ventilation cooling is an entirely different matter.

School learning areas require an adequate heating system and an efficient ventilation system. The following are essential in maintaining a comfortable thermal environment in school learning areas:

- individual room control
- rapid morning warm-up
- good air distribution
- quick response to thermal changes
- air filtration
- quiet operation
- adequate ventilation for air freshness and odor control
- up to 100 percent of system's total capacity for ventilation cooling
- cold window downdraft control
- flexibility for relocation of building

Criteria for Heating and Ventilation

Atmospheric Criteria			Desirable	Tolerance
Temperature	Outside Temperature	90 F°	78°	± 2°
		0 F°	72°	± 2°
Relative Humidity	Outside Temperature	90 F°	50%	± 5%
		0 F°	30%	± 5%
Outside Air		CFM per sq. ft. CFM per person	0.3 to 0.8 15 to 30	0.2 8
Air Changes		per hour	6 to 8	5
Air Movement		velocity: FPM	25 to 40	± 10

Acoustics

Every effort should be made to control the noise level within the relocatable learning facility. Since the majority of extraneous noise originates below the four foot level and since this is one of the largest single areas, carpet should be considered for the floor surface. The small difference in cost will be offset by the saving in maintenance. This carpet should be of the non-mildew and verminproof quality. The majority of the school boards reporting on portables across Canada were using either linoleum or vinyl asbestos tile. Among the newer portables built, however, there has been an increase in the use of carpets and the school boards who have had experience with carpets say the improved acoustics have enhanced the learning environment. An important saving in cleaning was also achieved.

Other materials such as acoustic ceiling tile and vinyl wall coverings also add greatly to the control of the noise level. Drapes cut down noise but are generally found to be undesirable due to high initial cost and expensive maintenance.

Electrical Outlets

Where the use of audio-visual equipment is anticipated, four duplex electrical receptacles are preferred.

Ceiling Heights

Ceiling heights depend on the type of roof and are, in turn, affected by the total over-all heights which must meet standards of the Department of Transport. The ceiling heights for the different roof types should be as follows:

Flat Roofs

The minimum ceiling height should be 9 ft. and no beams or other obstructions should be lower than 8 ft., except fluorescent light fixtures.

Sloping Roofs

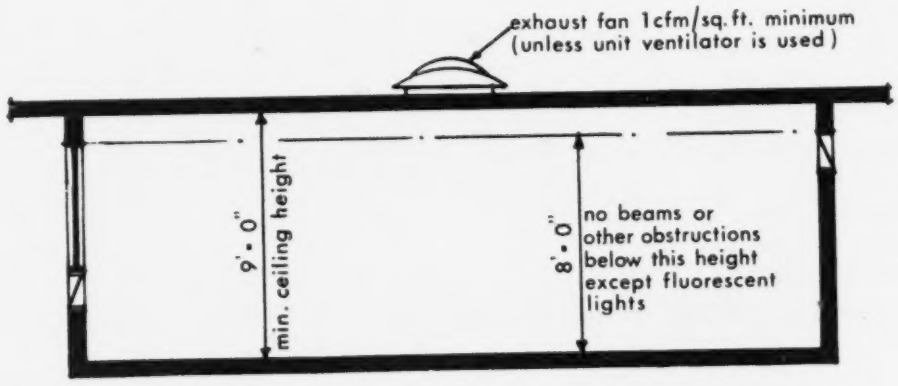
Sloping roofs with horizontal false ceilings should be a minimum height of 8 ft. at the false ceiling with no obstructions below that height, except ceiling mounted lighting fixtures.

Fire Regulations

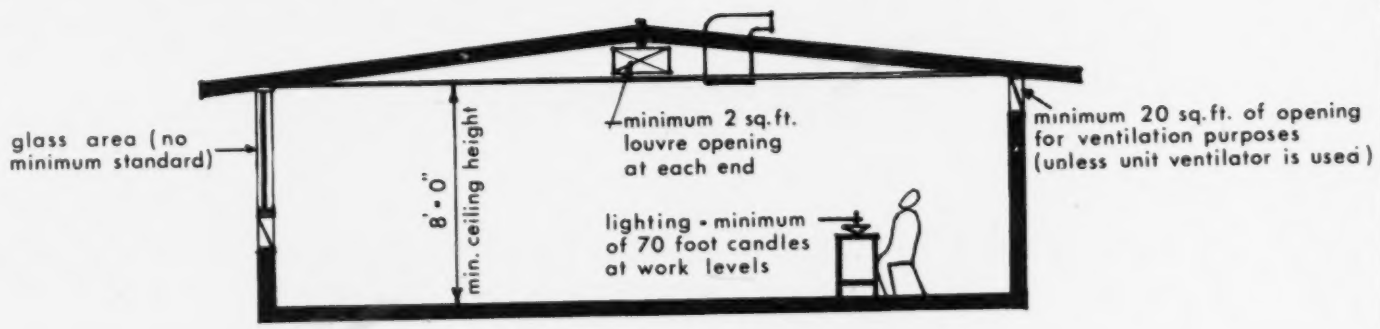
For information on interior fire regulations refer to "Building Fire Safety Design Standard" published by the Department of the Attorney General. Page 90, Appendix B, of the publication specifically deals with "Portable Classrooms".

minimum standards: relocatable learning facilities

Flat Roof



Sloping Roof with False Ceiling



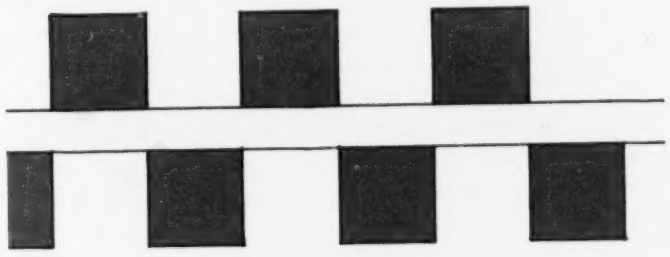
Future of relocatables

The future of the relocatable is promising. It will, however, require more flexibility and creative planning on the part of school boards, professional designers, and manufacturers.

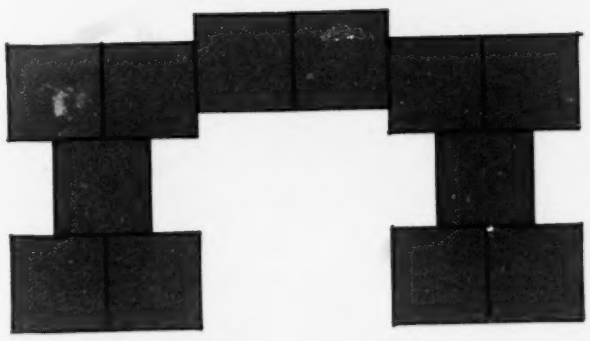
In order to expand the usefulness of relocatables, greater consideration should be given to including washroom facilities and connecting passageways. School boards might also consider grouping relocatables in clusters of three or four units divided by removable walls. But if its full operational potential is to be realized, school boards, professional designers, and manufacturers will need to exhibit increased creativity in planning and greater flexibility in utilization.

various plan arrangements

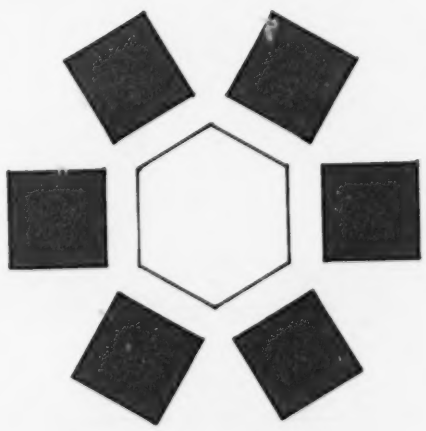
Connected Row



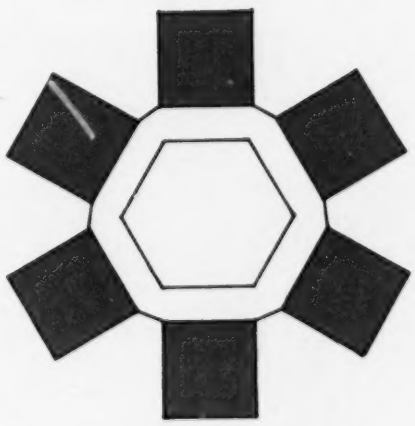
Cluster



Open Court



Closed Court

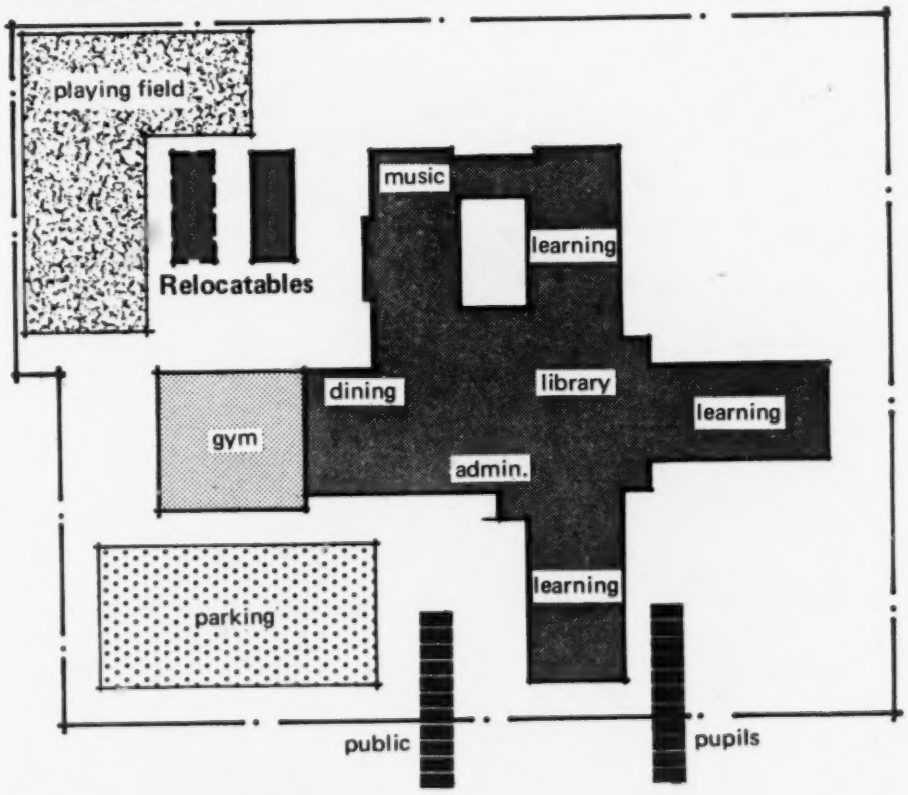


location

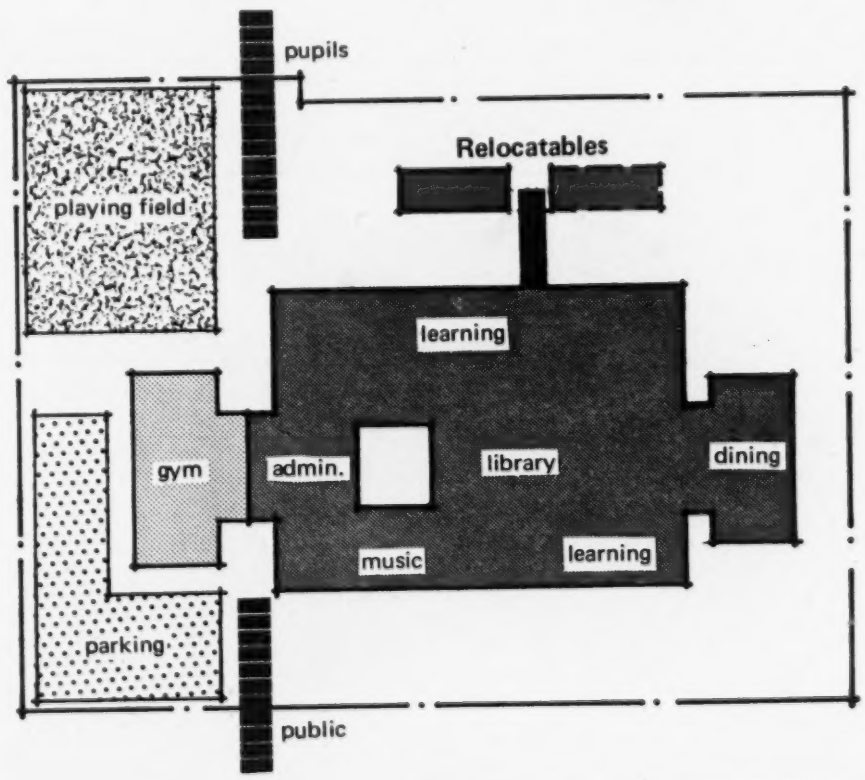
The placement of the single relocatable and the grouping of several relocatables should be considered carefully. Factors affecting sun control and placement in relation to the main building are very important and should be planned. The booklet issued by School Planning and Building Research of the Ontario Department of Education entitled "Site" should be consulted.

Other materials such as sodding and planters used to enhance the site can also be relocated. These may seem an extra frill but they add immensely to reaction to the portables by students, teachers, and the community.

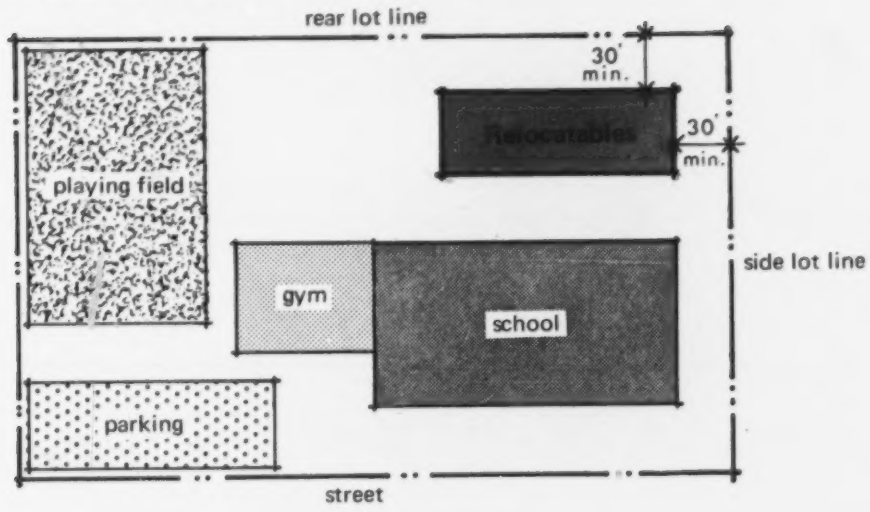
reasonable access to common facilities is desirable



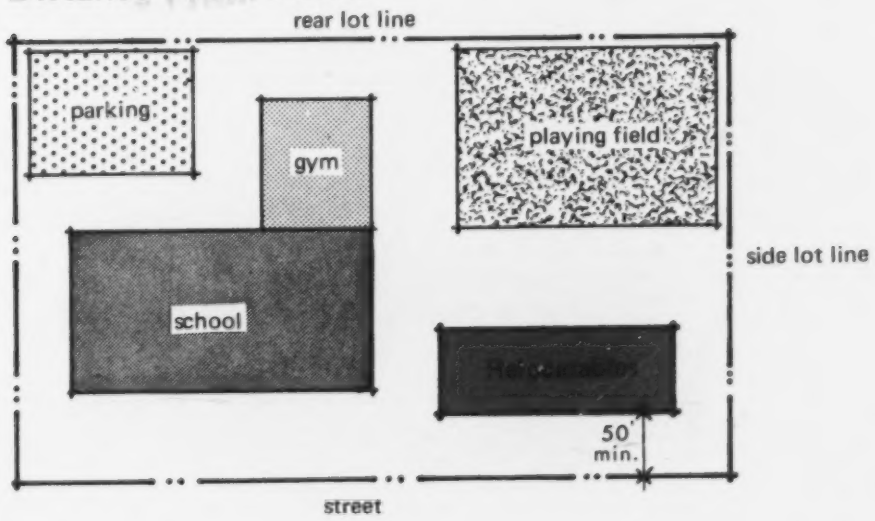
access to the main school and proximity of services should be considered



Distance From Rear Lot Line



Distance From Street

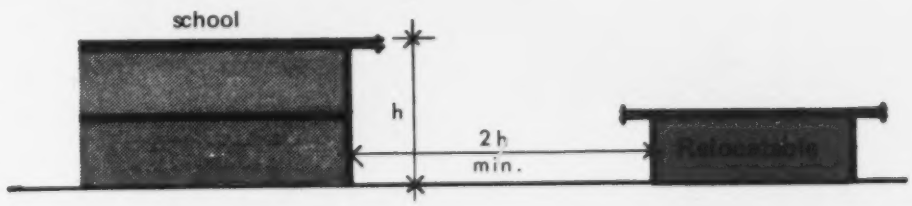


Note

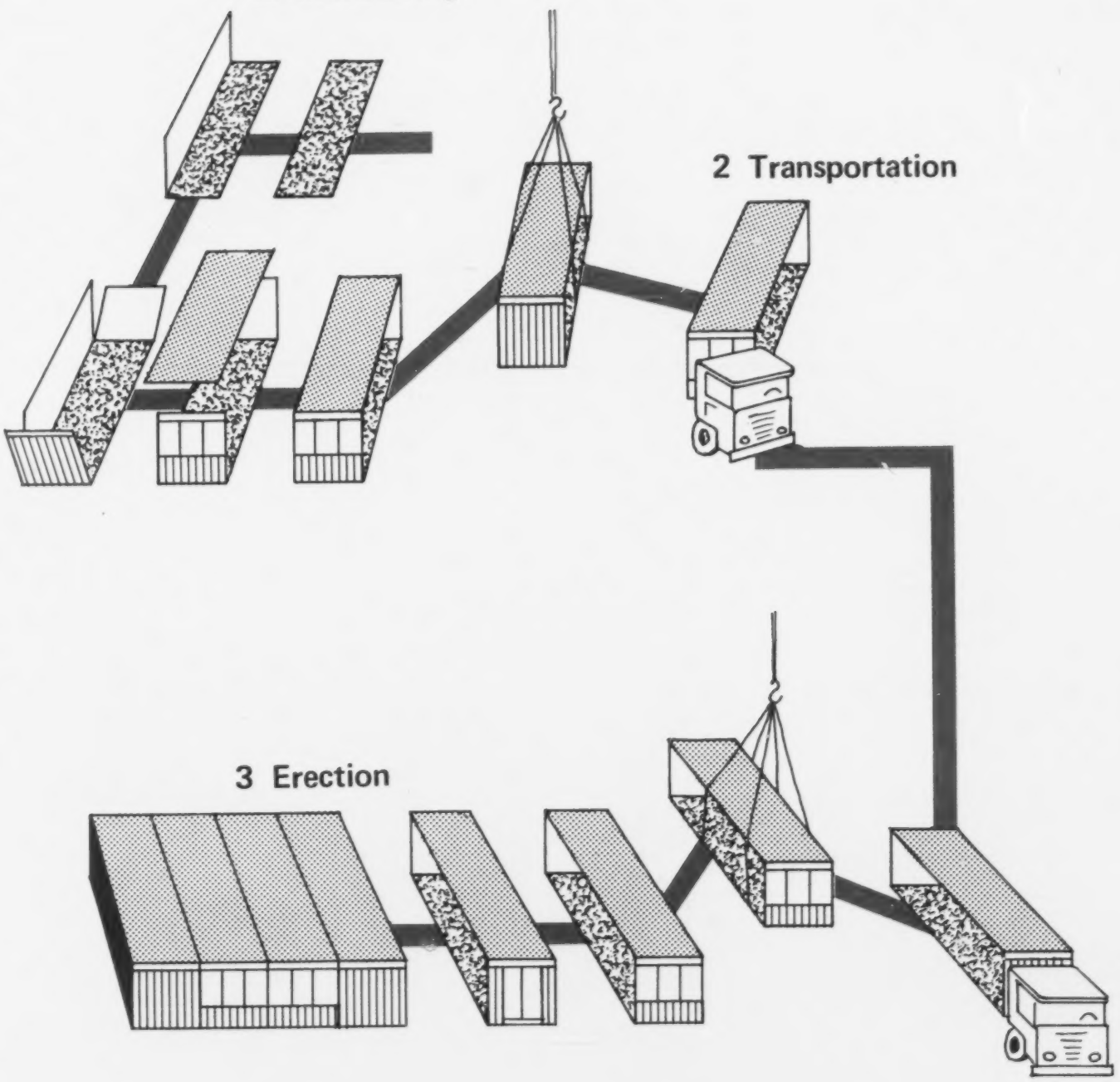
these restrictions apply in urban areas, when the sides of the relocatables have glazed areas facing the indicated boundaries.

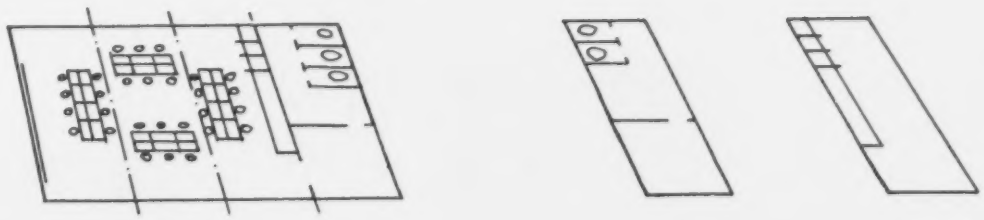
Distance From School

applies where relocatable has glazed areas facing school

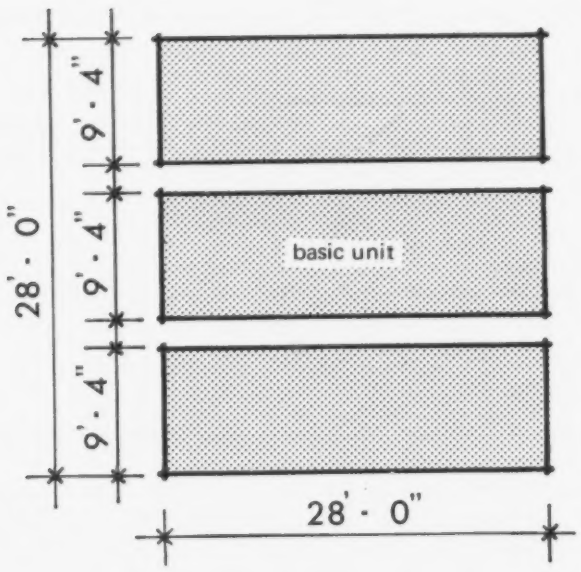


proposal for a divisible/relocatable learning facility





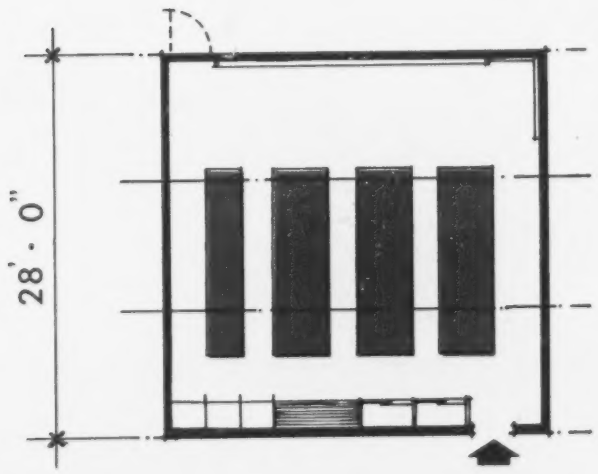
proposed relocatable learning facilities



The Structure

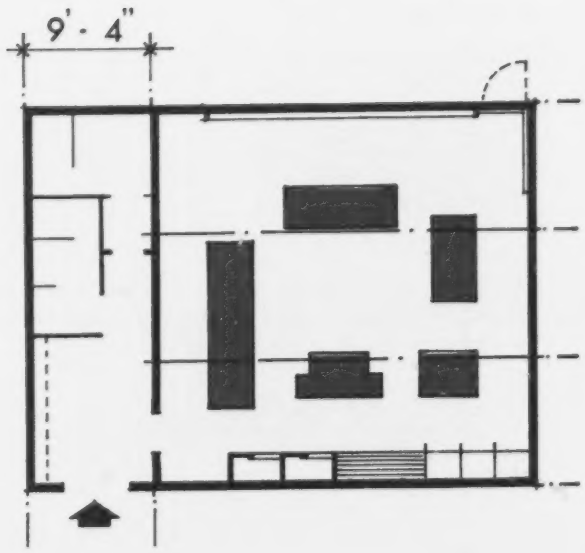
The learning area is constructed from three units each 9'-4" wide x 28'-0" long.

Each unit should include: any windows or doors, entire side walls, roof, floor and utilities: all combined and prefinished for greatest ease of shipping and rapid assembly at a given site.



Learning Area

		gross	net
area in square feet	=	784	756
number of students	=		35
area per student place	=		21.6



The area provided is sufficient for formal seating as well as for grouping of students.

Note:
Extra units can easily be added to provide washroom facilities, etc.

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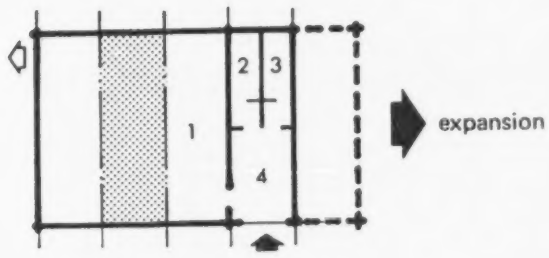
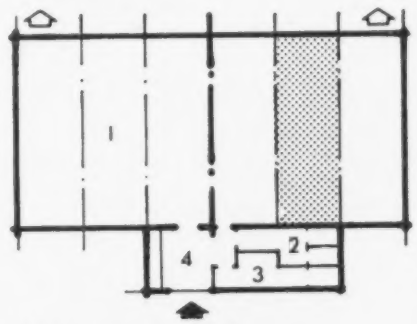
relocatable learning areas: groups of two

Single Learning Area



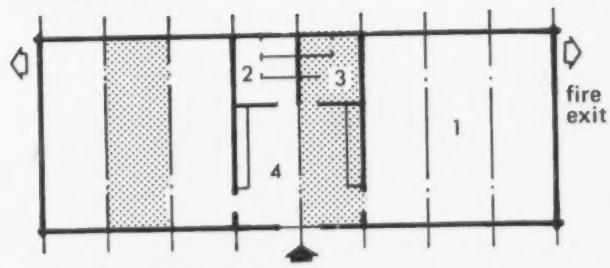
units can be added to provide more learning areas

Scheme 1



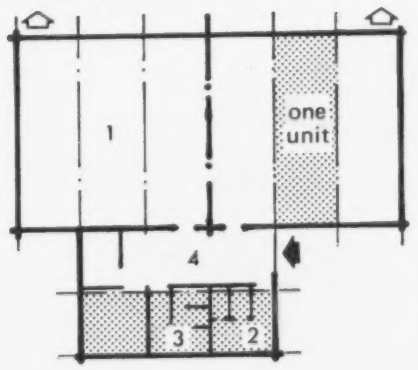
learning area: 6 units
ancillary area: 1 unit

Scheme 2

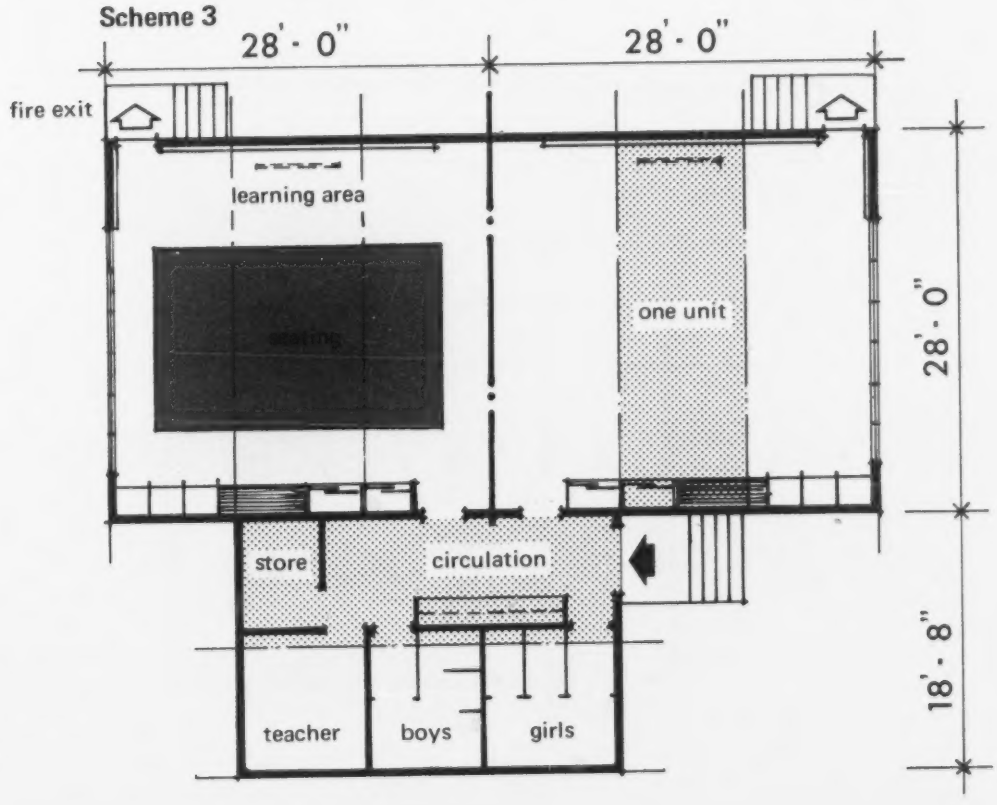


learning area: 6 units
ancillary area: 2 units

Scheme 3



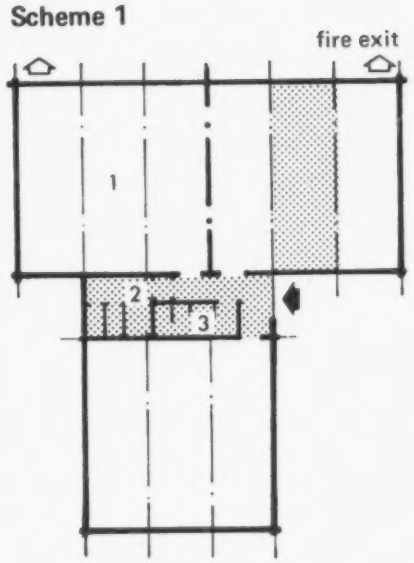
Scheme 3



1 learning area
2 girls' washroom
3 boys' washroom
4 circulation

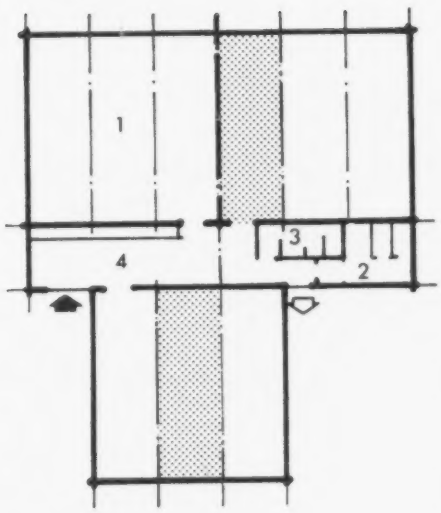
relocatable learning areas:groups of three

Scheme 1



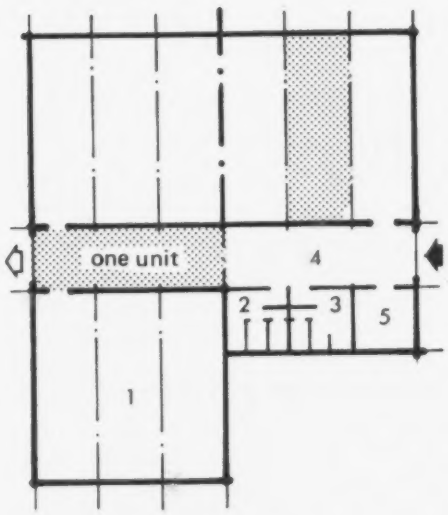
learning area: 9 units
ancillary area: 1 unit

Scheme 2



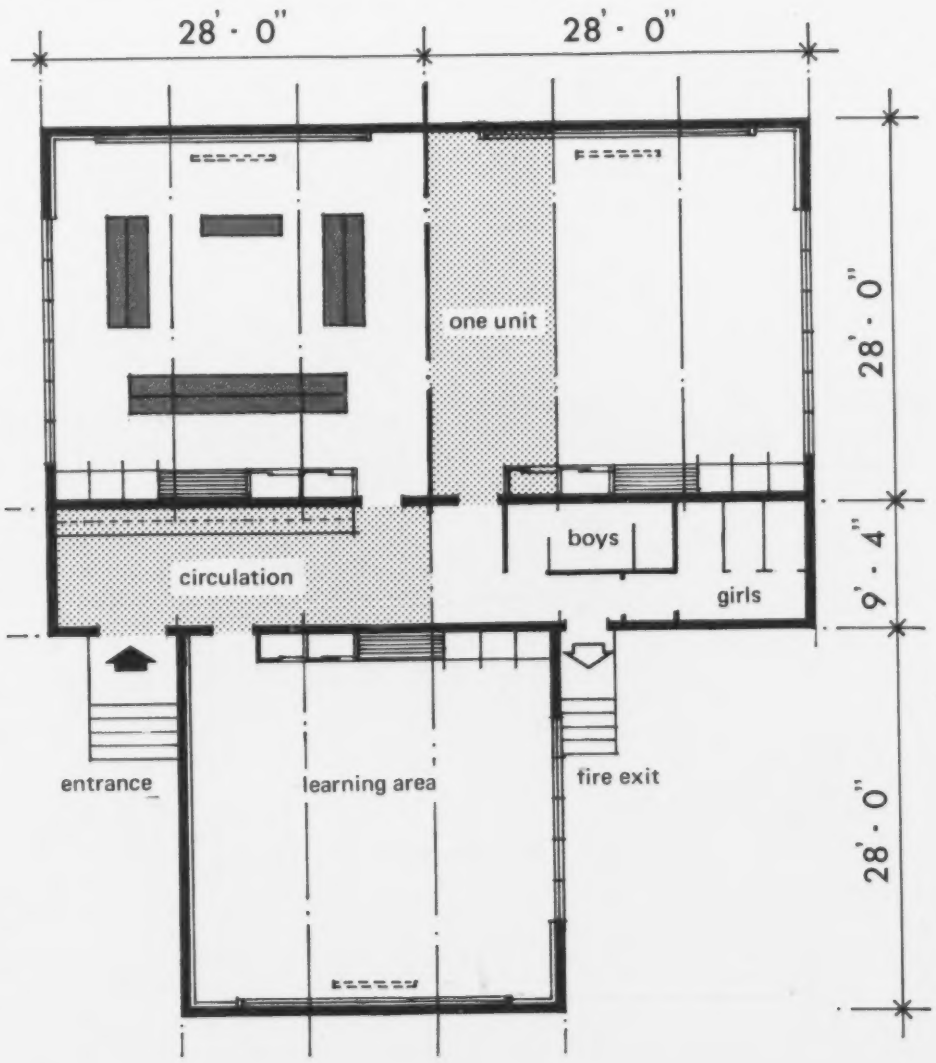
learning area: 9 units
ancillary area: 2 units

Scheme 3



learning area: 9 units
ancillary area: 3 units

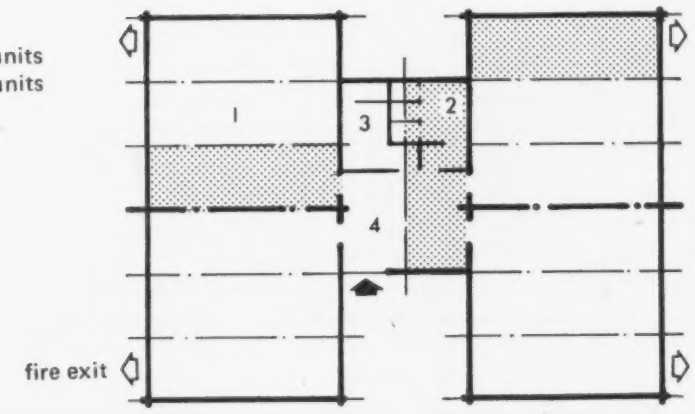
Scheme 2



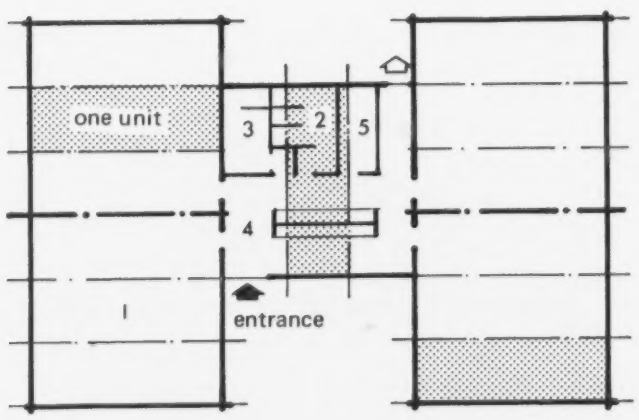
1 learning area
2 girls' washroom
3 boys' washroom
4 circulation
5 storage room

relocatable learning areas: groups of four

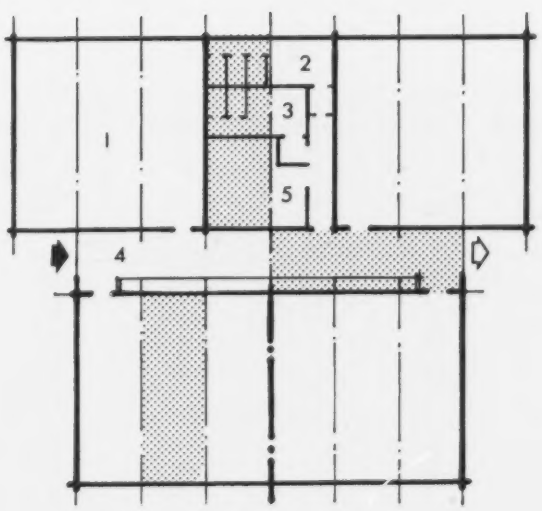
Scheme 1
learning area: 12 units
ancillary area: 2 units



Scheme 2
learning area: 12 units
ancillary area: 3 units



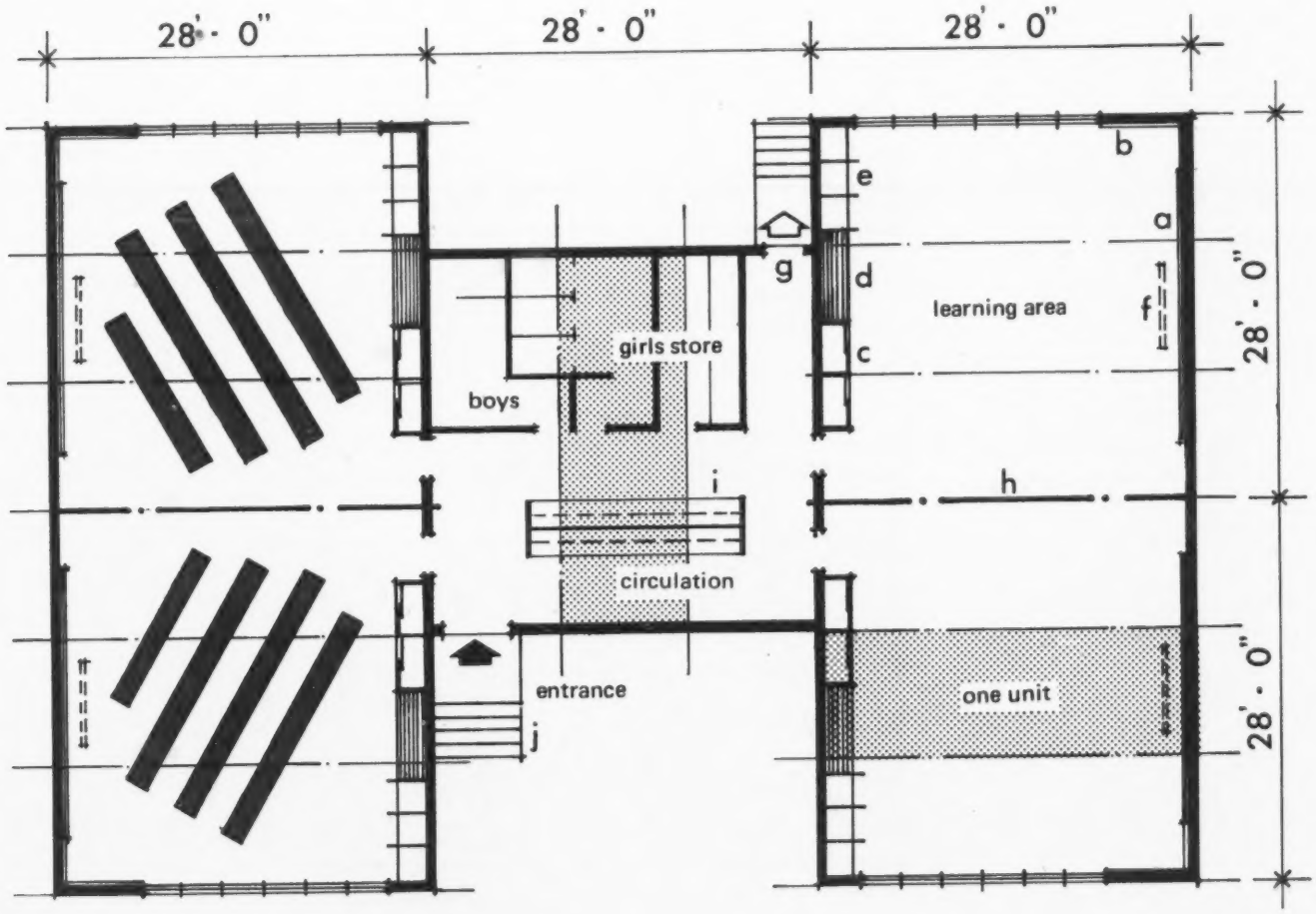
Scheme 3
learning area: 12 units
ancillary area: 4 units



1 learning area
2 girls' washroom
3 boys' washroom
4 circulation
5 storage room

four learning areas: plan

Scheme 2

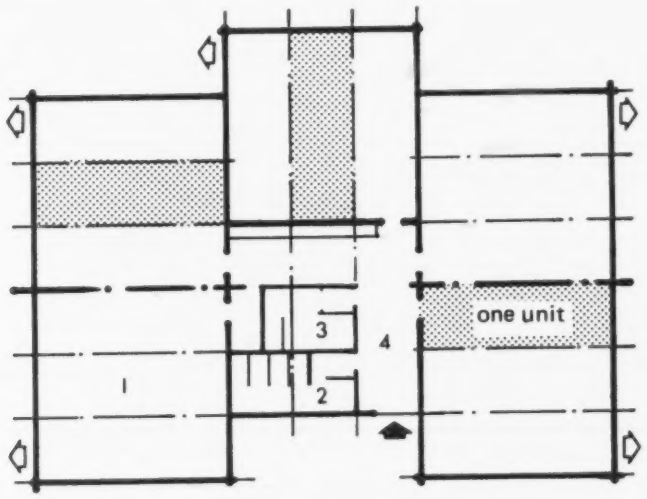


Basic Facilities

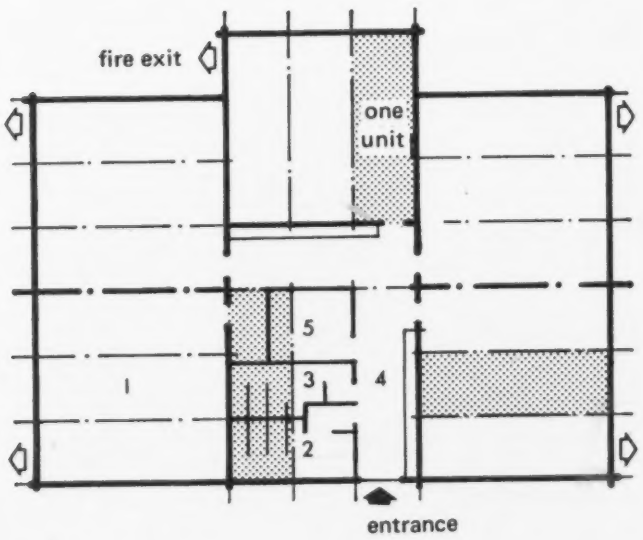
- **a** chalkboard
- **b** tackboard
- **c** supply cupboard
- **d** work counter with sink
- **e** study carrels
- **f** projection screen
- **g** fire exit door (where required)
- **h** operable partition (where possible)
- **i** coat storage
- **j** platform and steps

relocatable learning areas: groups of five

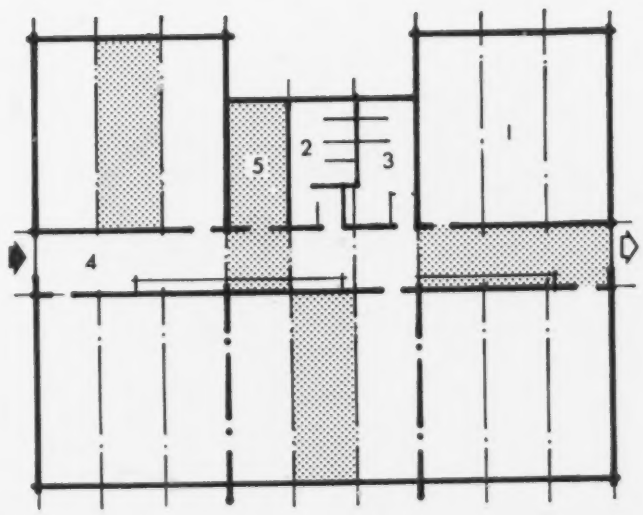
Scheme 1
learning area: 15 units
ancillary area: 3 units



Scheme 2
learning area: 15 units
ancillary area: 4 units



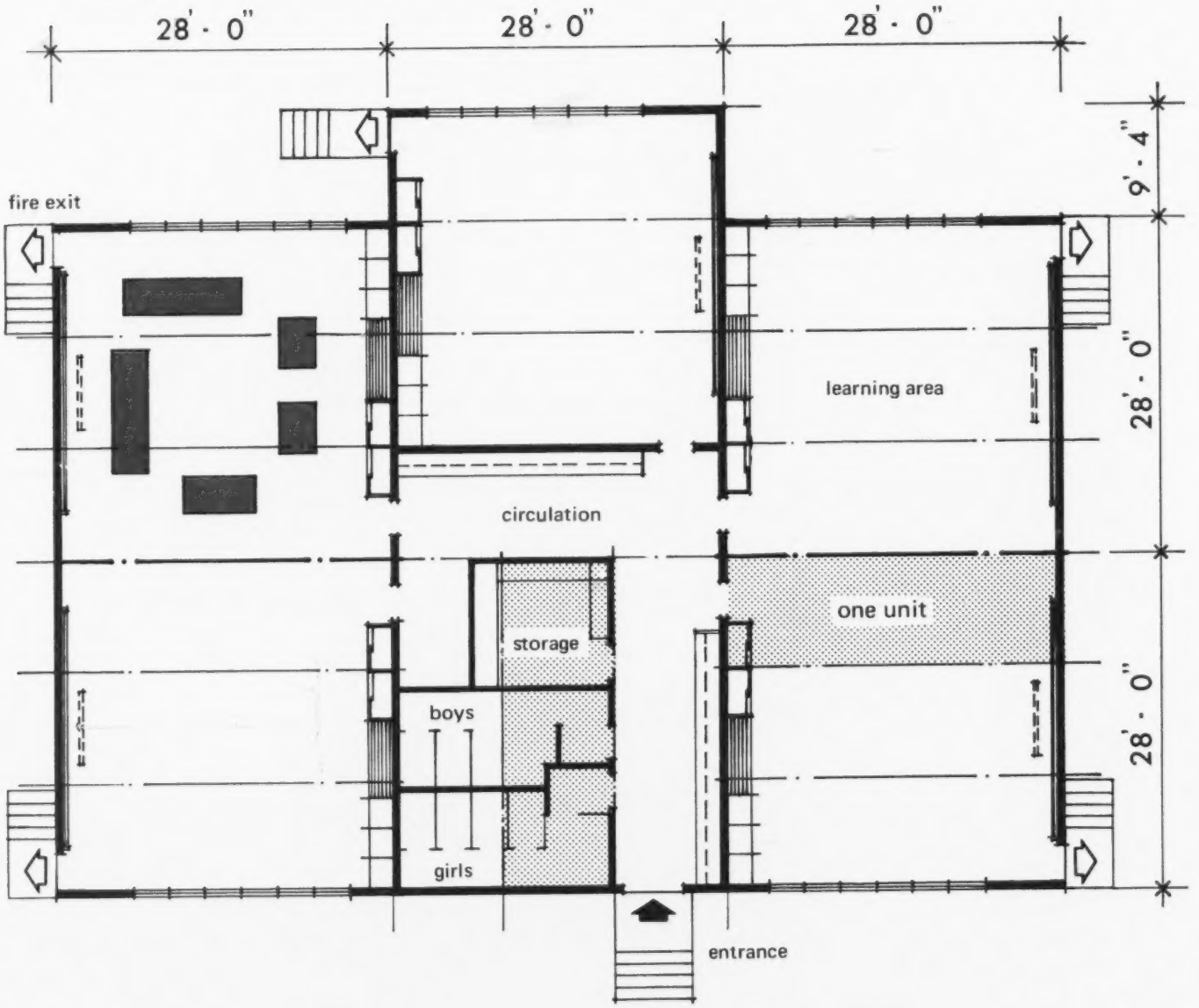
Scheme 3
learning area: 15 units
ancillary area: 5 units



1 learning area
2 girls' washroom
3 boys' washroom
4 circulation
5 storage room

five learning areas: plan

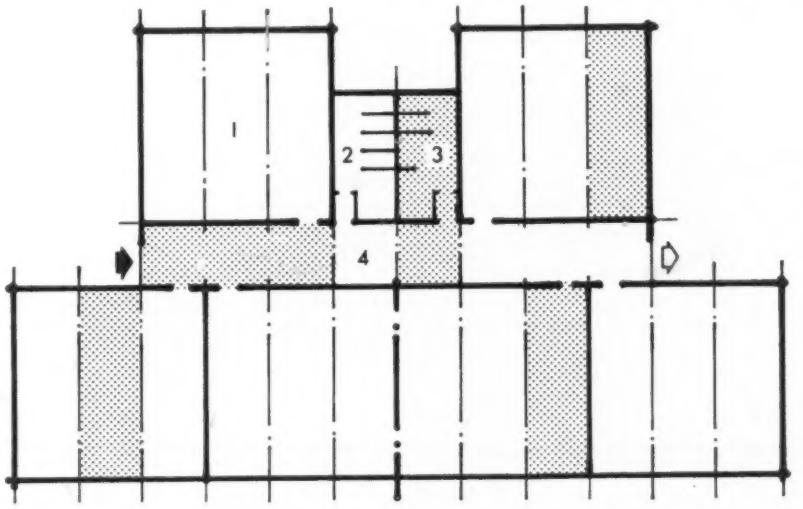
Scheme 2



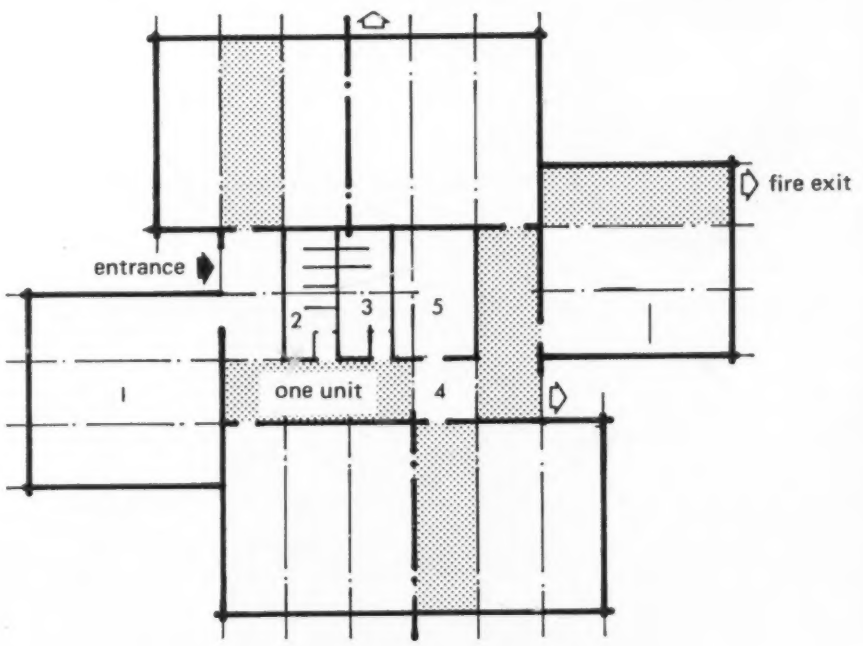
Note:
for construction requirements of portables over 4,000 sq. ft. in area refer to the National Building Code.

relocatable learning areas: groups of six

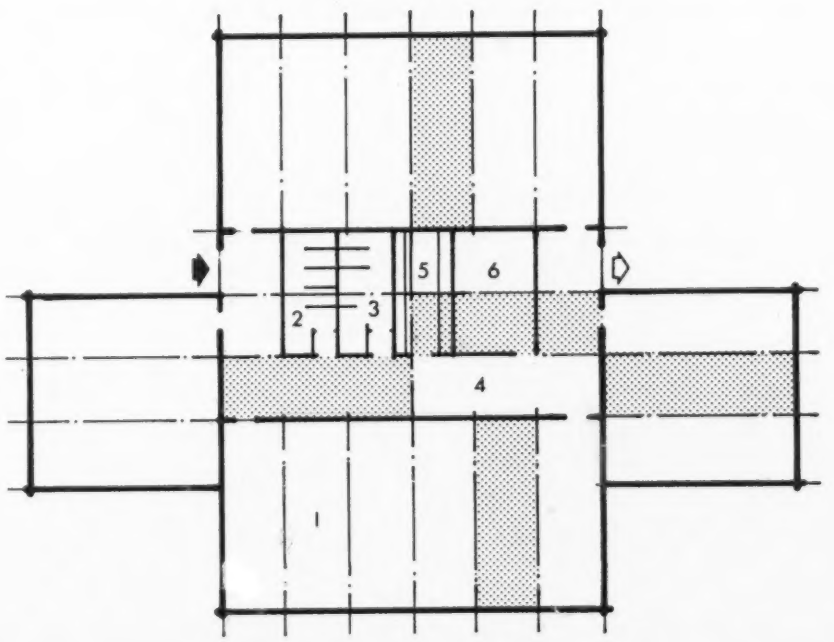
Scheme 1
learning area: 18 units
ancillary area: 4 units



Scheme 2
learning area: 18 units
ancillary area: 5 units



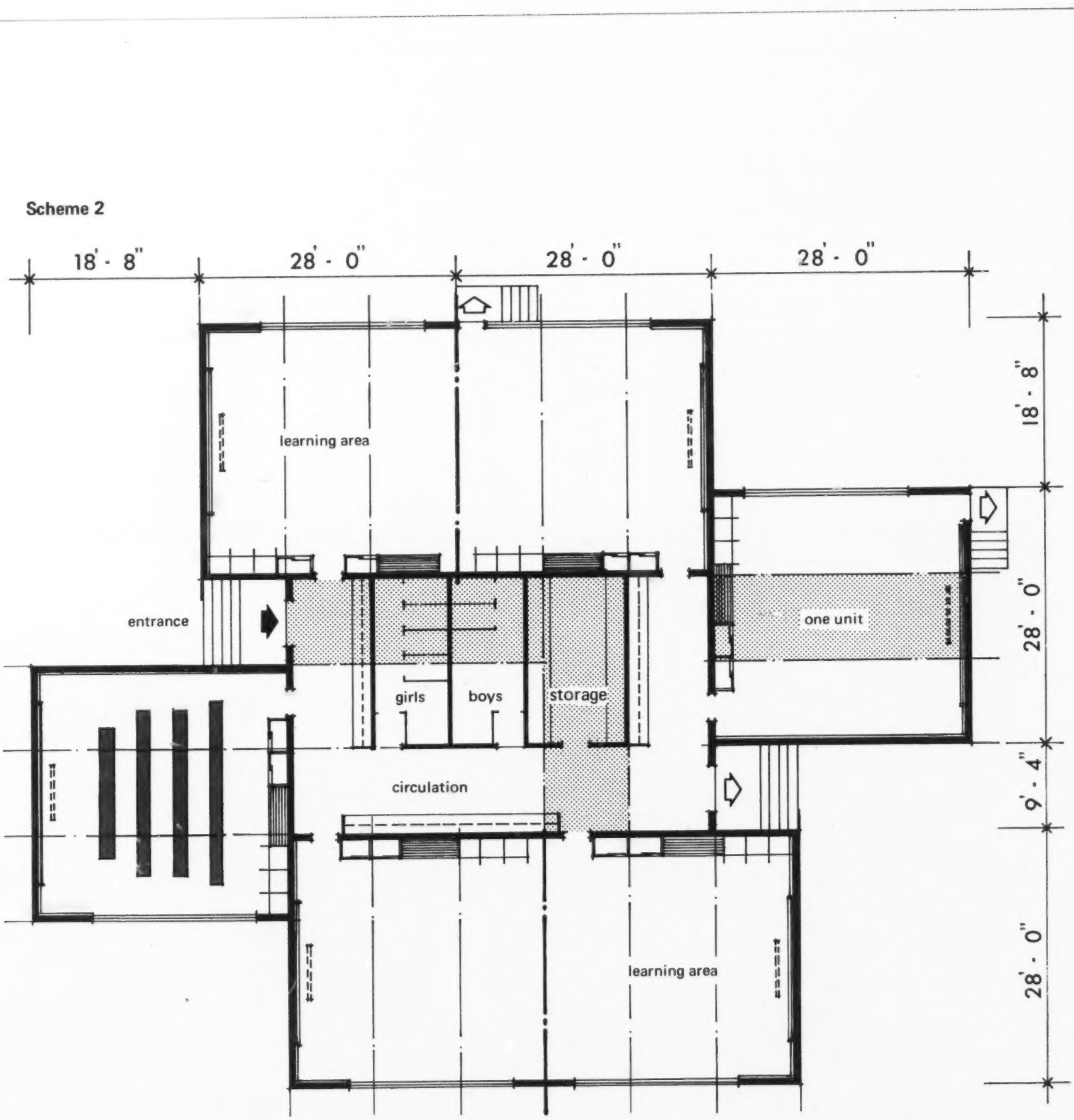
Scheme 3
learning area: 18 units
ancillary area: 6 units



1 learning area
2 girls' washroom
3 boys' washroom
4 circulation
5 storage room
6 teachers' workroom

six learning areas: plan

Scheme 2



Acknowledgement

Appreciation is expressed for assistance and co-operation received from:

Public School Boards
Separate School Boards
Mr. R. Douglas Creelman, Industrial Designer